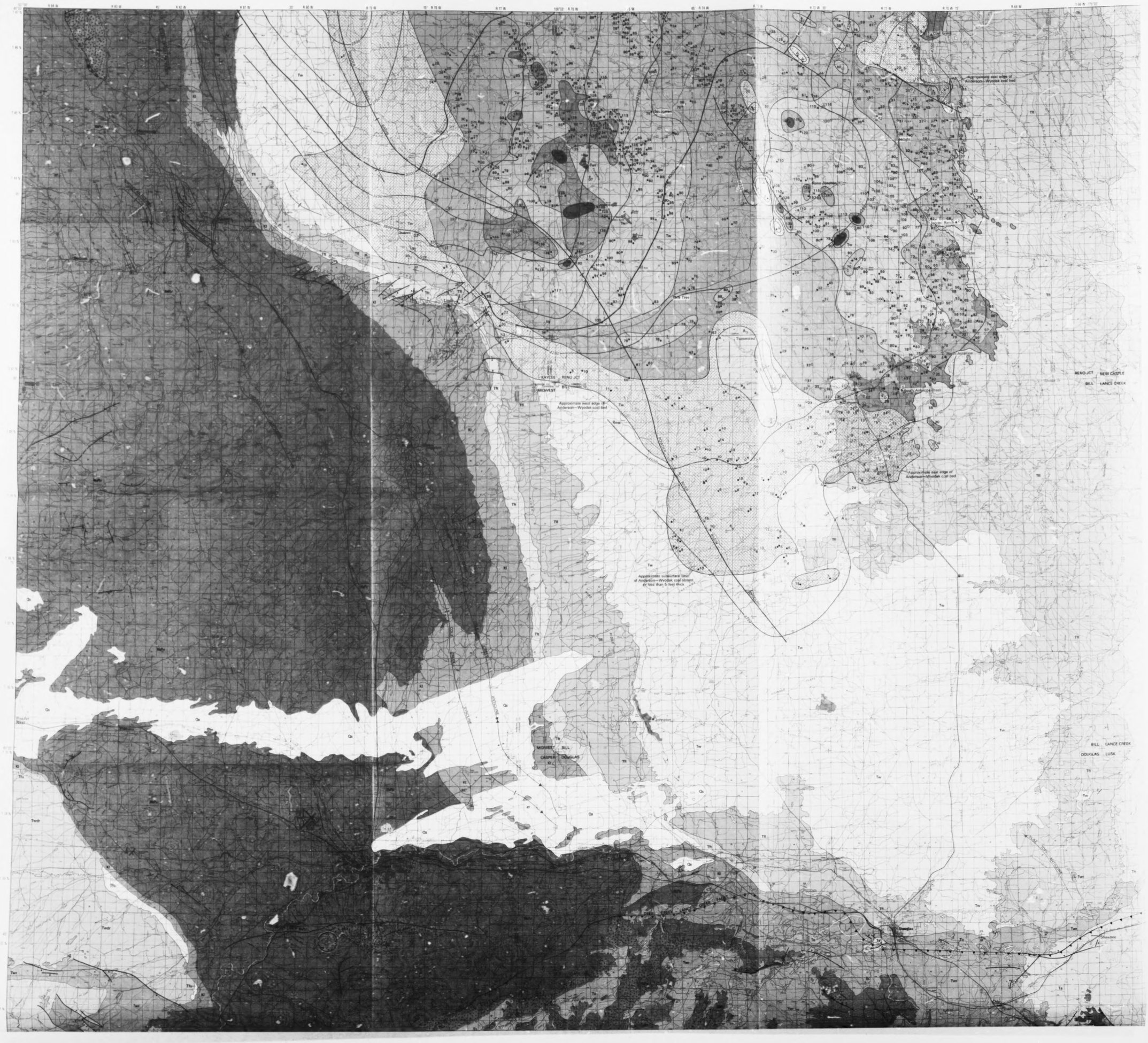
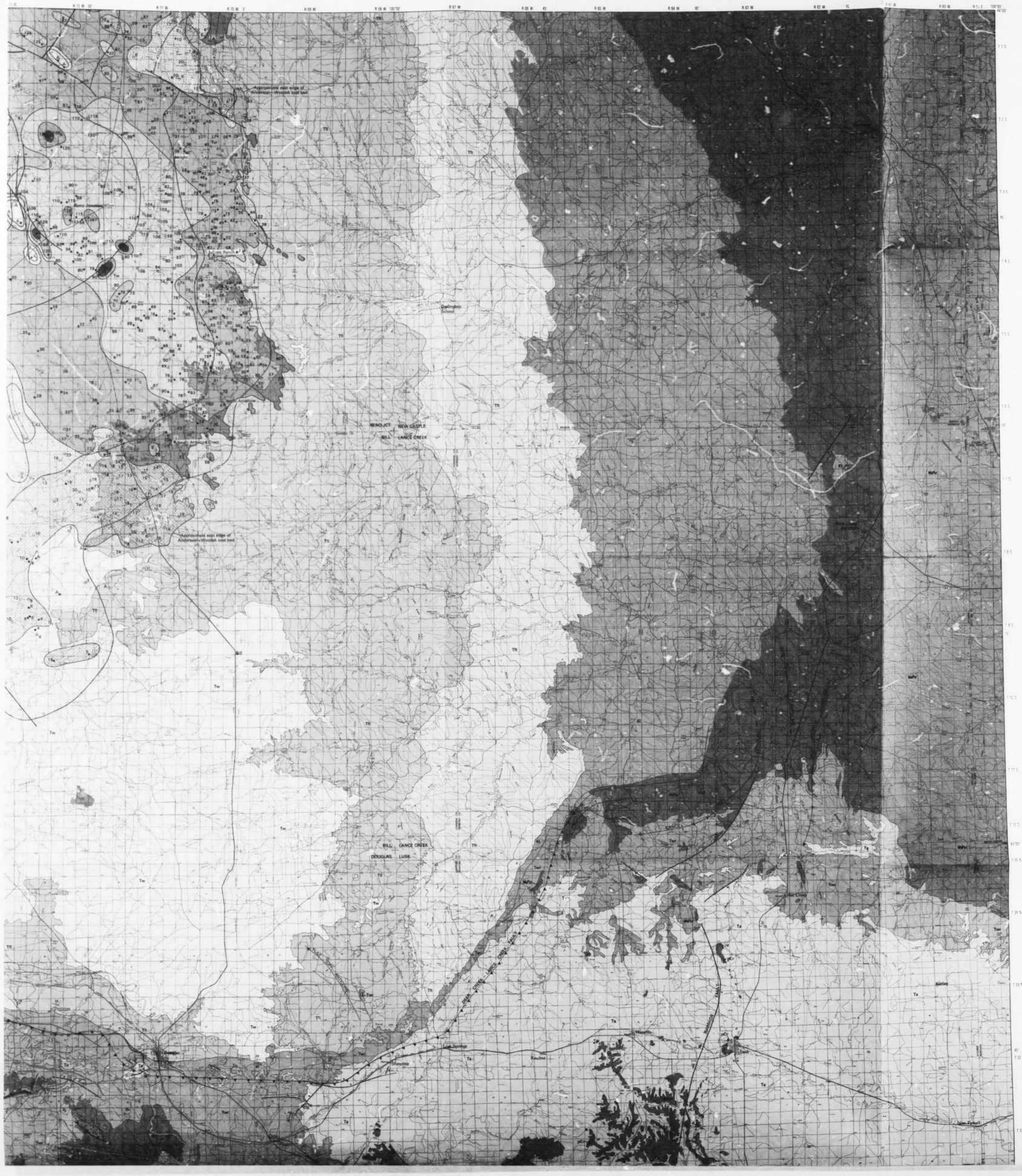
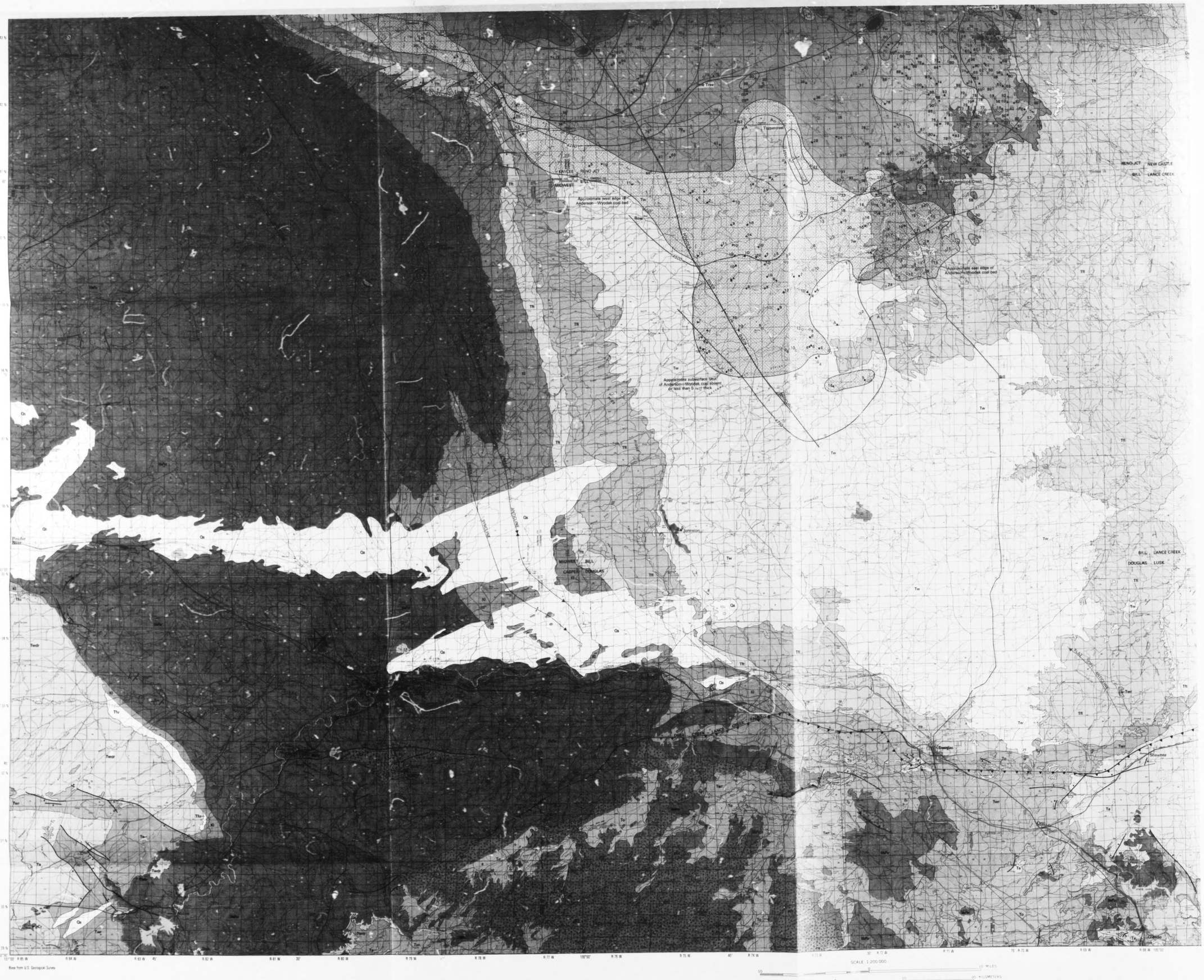
DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY




Approximate east edge of Anderson–Wyodak coal bed
Approximate east edge of Anderson–Wyodak coal bed
Dalrington School
Lance Creek
Ranch
NEW CASTLE
LANCE CREEK
RENO JCT
BILL
DOUGLAS
LUSK
Keeline
Glenrock
Douglas
Converse
Antelope Creek
Bill
Lance Creek


RENO JCT
NEW CASTLE
BILL
LANCE CREEK
KAYCEE
MIDWEST
Approximate west edge of Anderson—Wyodak coal bed
Approximate east edge of Anderson—Wyodak coal bed
Approximate subsurface limit of Anderson—Wyodak coal absent or less than 5 feet thick
Douglas
Glenrock
Shawnee
Johnson
Powder River
Twdr
Twsr
Twr
Tw
Tfu
Tfl
Ta
To
Tcr
Ks
Kl
Kfh
Kpc
Ks
Qa
Qt
Qls
Qb
Qc
Qg
Qp
Qu
Qs
Qe
Qd
Qr
Qv
Qm
Qw
Qo
Qh
Qi
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Qk
Qj
Qn
Qq
Qz
Qy
Qx
Qaa
Qbb
Qcc
Qdd
Qee
Qff
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Qhh
Qii
Qjj
Qkk
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Qyy
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Qaaa
Qbbb
Qccc
Qddd
Qeee
Qfff
Qggg
Qhhh
Qiii
Qjjj
Qkkk
Qlll
Qmmm
Qnnn
Qooo
Qppp
Qqqq
Qrrr
Qsss
Qttt
Quuu
Qvvv
Qwww
Qxxx
Qyyy
Qzzz
Qaaaa
Qbbbb
Qcccc
Qdddd
Qeeee
Qffff
Qgggg
Qhhhh
Qiiii
Qjjjj
Qkkkk
Qllll
Qmmmm
Qnnnn
Qoooo
Qpppp
Qqqqq
Qrrrr
Qssss
Qtttt
Quuuu
Qvvvv
Qwwww
Qxxxx
Qyyyy
Qzzzz
Qaaaaa
Qbbbbb
Qccccc
Qddddd
Qeeeee
Qfffff
Qggggg
Qhhhhh
Qiiiii
Qjjjjj
Qkkkkk
Qlllll
Qmmmmm
Qnnnnn
Qooooo
Qppppp
Qqqqqq
Qrrrrr
Qssssss
Qtttttt
Quuuuuu
Qvvvvvv
Qwwwwww
Qxxxxxx
Qyyyyyy
Qzzzzzz
Qaaaaaa
Qbbbbbb
Qccccccc
Qddddddd
Qeeeeeee
Qfffffff
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Qiiiiiii
Qjjjjjjj
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Qlllllll
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Qoooooo
Qpppppp
Qqqqqqq
Qr

SCALE 1:200,000

0 10 MILES

0 10 20 KILOMETERS

NATIONAL GEODETIC VERTICAL DATUM OF 1929

Geology mapped by N.M. Denson, G.H. Horn, D.L. Macke, and G.L. Bart 1975–83 or modified from previous maps
Well data as of June 21, 1988
Manuscript approved for publication August 12, 1988

Ta **Arikaree Formation (lower Miocene)**—Yellowish-gray to light-brownish-gray, very fine grained, massive to poorly bedded sandstone containing abundant grains (1/8–1/4 mm) of bluish-gray magnetite; some siltstone and limestone beds. Predominantly of eolian and volcanic origin. Altered chalky ash, in beds as much as 2 ft thick, common near base of formation. Poorly cemented conglomerate, as much as 75 ft thick and composed of pebbles derived mostly from Precambrian rocks, occurs locally near base of formation. Well-sorted grains, laterally persistent lithology, and the general absence of coarse detritus and locally derived debris characterize the formation. Thickness 0–1,050 ft. Average thickness is about 600 ft.

Twr **White River Formation (Oligocene)**—Interbedded grayish-brown, pink, light- to medium-gray, and green tuffaceous siltstone and conglomerate. Upper half is predominantly eolian except locally along the eastern flank of the Laramie Mountains, where it is highly conglomeratic and predominantly fluvial; the lower half is generally of fluvial origin. Thin beds of freshwater limestone and altered chalky ash beds occur locally. Conglomerate near base of formation is from 0 to 60 ft thick and is composed of pebbles and cobbles that were derived from Precambrian igneous and metamorphic rocks. The formation unconformably overlies everything from the Precambrian to the Eocene Wasatch Formation. The basal part consists of 130–200 ft of very hard, locally conglomeratic sandstone that forms the caprock on Pumpkin Buttes, near center of south half of sec. 32, T. 44 N., R. 75 W. Locally, basal unit is overlain by less than 10 ft of blocky, white and pink tuffaceous and bentonitic claystone that has yielded vertebrate fossils of early Oligocene age. Thickness from 0 to as much as 1,150 ft. Average thickness is about 500 ft.

Twb **Wagon Bed Formation (upper and middle Eocene)**—Siliceous bentonitic mudstone, claystone, sandstone, and altered yellowish-green, paleolive, and dark-greenish-gray tuff. Mostly fluvial, with major amounts of volcanic constituents. Present only in the southwestern part of the area. Conformably overlies the lower Eocene Wind River Formation at most places and is unconformably overlain by the Oligocene White River Formation. Formation contacts generally are sharp and show little or no transitional lithologies. One of the most impervious units in the Tertiary sequence. 0–160 ft thick.

Tw **Wasatch Formation (lower Eocene)**—Gray and reddish-pink siltstone and conglomeratic to fine-grained, arkosic sandstone; brown carbonaceous shale and coal, of fluvial and paludal origin. In general, the sandstone is coarser grained and contains two- to three times more heavy minerals than sandstones in the unconformably underlying Paleocene rocks. Conglomeratic beds are from 2 to 4 ft thick and are composed primarily of quartzitic sandstone; dark chert pebbles are locally present at the base. Lower part of the formation contains some of the largest uranium deposits in the Powder River Basin. The host rocks, generally are lenticular, very coarse grained, arkosic sandstones. The lower part may be Paleocene in age based on palynological evidence (Tschudy, 1976). However vertebrate fossils of early Eocene age (Dobson, 1977) have been found in these lower rocks in the southwestern part of the Powder River Basin and typical Paleocene pollen was not found at most of the vertebrate localities. The authors conclude the age of the Wasatch Formation in the Powder River Basin may only be Eocene, as shown on the geologic map of Wyoming (Love and Christiansen, 1985). Unconformably overlies the Fort Union Formation and is truncated by the present-day erosion surface. Thickness 0–2,250 ft.

Twdr **Wind River Formation (lower Eocene)**—In the extreme southwestern part of the area, the lower Eocene rocks are assigned to the Wind River Formation and are composed of gray siltstone, coarse-grained sandstone, and poorly sorted conglomerate derived from Mesozoic, Paleozoic, and Precambrian rocks. Unconformably overlies the Paleocene Fort Union Formation, the Upper Cretaceous Lance Formation, and older Mesozoic and Paleozoic rocks. Thickness 0–550 ft.

Tfu **Fort Union Formation undivided (Paleocene)**—The Lebo and Tullock Members of the Fort Union Formation cannot be differentiated in the extreme northwestern and southwestern parts of the area. In the northwestern part, the lower 500 ft of the Fort Union Formation is composed of brown, ferruginous, resistant, ledge-forming sandstone interbedded with gray siltstone and shale, and is unconformably overlain by very light gray siltstone and gray, shaly sandstone, with some thin, reddish-brown, resistant, ferruginous sandstone ledges. The upper 1,200 ft contains many thick zones of carbonaceous shale interbedded with siltstone and thin lenticular conglomerate containing mostly quartzite sandstone pebbles and minor amounts of dolomite and limestone pebbles. Maximum thickness of unit in the northwestern part of mapped area is about 3,575 ft. In the extreme southwestern part of the area, the Fort Union Formation is composed of coarse-grained, weakly indurated, arkosic sandstone and conglomerate; it contains variegated red and gray siltstone in the upper part, and lenticular interbeds of carbonaceous shale and siltstone in the lower part. Thickness of unit in southwestern part about 235 ft thick.

Tfl **Lebo Member**—Light- to dark-gray, very fine grained to conglomeratic sandstone interbedded with varying amounts of gray siltstone, claystone, carbonaceous shale, and coal, of fluvial and paludal origin. Slabs and boulders of orthoquartzite containing numerous leaf and root impressions, derived from beds of silicified swamp deposits, occur locally on the surface. Brown-weathering, calcareous iron-

Tfu **Tullock Member**—Light- to dark-gray, very fine grained to conglomeratic sandstone interbedded with varying amounts of gray siltstone, claystone, carbonaceous shale, and coal, of fluvial and paludal origin. Slabs and boulders of orthoquartzite containing numerous leaf and root impressions, derived from beds of silicified swamp deposits, occur locally on the surface. Brown-weathering, calcareous iron-concretionary sandstone and dark, massive, lenticular, concretionary sandstone. Many thin coal beds in the lower half and generally absent in upper half of formation. Dinosaur-bone fragments common throughout the unit, but absent in the overlying Tullock. Beds of the Lance are massive and lenticular, and dip measurements are difficult to obtain. At most localities, the contact with the overlying Tullock is arbitrarily drawn at the base of the lowest coal bed. In the subsurface, the Lance-Tullock contact is determined on the basis of resistivity, gamma ray, and sonic logs, and is placed at the top of what appears to be a well-developed although locally lenticular, paleosol. The base of the Lance is drawn at the top of the conformably underlying white marine sandstone of the Colgate Member of the Fox Hills Sandstone. The Lance and overlying Tertiary formations are entirely of nonmarine origin. In contrast, the older sedimentary rocks are of nonmarine and marine origin. The Lance Formation was named from outcrops in the Lance Creek quadrangle, from 45 to 50 mi northeast of Douglas, Wyoming. Thickness ranges from 1,800 to 3,360 ft.

MzPe **Sedimentary rocks (Mesozoic and Paleozoic)**—Shale, siltstone, sandstone, conglomeratic, anhydritic, dolomitic, and limestone of continental and marine origin. Unit includes all sedimentary rocks older than the Upper Cretaceous Lance Formation. This sequence lies unconformably on rocks of Precambrian age. Thickness 5,500–10,000 ft.

pC **Igneous and metamorphic rocks (Precambrian)**

Contact—Dashed where approximately located, dotted where concealed

High-angle fault—Dashed where approximately located, dotted where concealed. Bar and ball on downthrown side

Thrust fault—Dashed where approximately located, dotted where concealed. Sawteeth on upper plate

Anticline—Showing axial trace and direction of plunge

Syncline—Showing axial trace and direction of plunge

Strike and dip of beds

Structure contour constructed on top of Anderson-Wyodak coal bed—Dashed where projected above ground level. Contour interval 250 ft

Thickness of Anderson-Wyodak coal bed—

- 150 – 200 ft
- 125 – 150 ft
- 75 – 125 ft
- 25 – 75 ft
- 5 – 25 ft
- 0 – 5 ft

May include lenticular coal or carbonaceous shale beds less than 5 ft thick, but none are economically important. The approximate east margin of the important coal-bearing rocks coincides with the top of the Tullock Member of the Fort Union Formation

Exploratory hole for uranium and coal—Generally less than 1,500 ft deep. Number beside symbol is coal thickness

Oil and gas test well—Number beside symbol is coal thickness. A" indicates drill hole in which Anderson coal bed is absent

Coal mine—Open pit (Locations as of January, 1988, supplied by the Office of Surface Mining Region V Western Field Operations, Reclamation and Enforcement, Denver, CO.) Map numbers keyed to list of mines in Table 1

INTRODUCTION

The map shows the thickness of the Anderson-Wyodak coal bed, where present, in the southern part of the Powder River Basin. Data for these thicknesses were obtained mostly from electric and gamma ray logs, following procedures outlined on U.S. Geological Survey Miscellaneous Investigations Maps I-849E (Denson and others, 1973) and I-1201 (Denson and others, 1980). The drill-hole locations of oil and gas test wells are indicated by solid black dots. Shallow exploratory holes, usually less than 1,500 ft deep, drilled for uranium and coal are shown by open circles. Test wells in which the Anderson Coal bed is absent are indicated by the letter "A". Within reasonable limits, these data provide a measure of how much coal in the Anderson-Wyodak seam underlies any given tract of land in the map area.

In this report the Anderson and Wyodak coal beds are considered to form a single, laterally continuous coal resource unit, although the Wyodak bed splits to the west into the Anderson and Canyon beds (Denson and others, 1973; Denson and others, 1980). Where the Anderson and Canyon coal beds diverge and the noncoaly rocks between them exceed the thickness of either coal, they are referred to separately as the Anderson or the Canyon.

Stratigraphic relationships and correlation of the Paleocene and Eocene coals in the south half of the Powder River Basin are described by Denson and others (1980). Heavy-mineral studies by Denson, Macke, and Schumann (1989) were used in correlating the rock units. Depositional controls on the geometry of the Wyodak-Anderson coal bed in northeastern Wyoming are described by Warwick and Stanton (1988). At most localities in the southern part of the Powder River Basin, the Anderson-Wyodak coal bed occurs stratigraphically within 200 ft of the top of the Lebo member of the Fort Union Formation of Paleocene age and the base of the unconformably overlying Wasatch Formation of early Eocene age.

ECONOMIC IMPORTANCE

The Anderson-Wyodak coal bed, in the Powder River Basin, is one of the world's largest known coal deposits (Pierce and others, 1992). It occurs as a single bed, or a group of closely spaced beds separated by thin partings of noncoaly rocks. The thickness ranges from 5 ft to 190 ft. Conditions leading to the formation of such extensive coal deposits, about 50–60 m (~400 ft) are discussed by Brown (1962), Flores (1982), and Kent (1986). In the south half of the Powder River Basin the Wyodak and Anderson coal beds are subbituminous B in rank. Available analyses of coal (as received) from widely spaced localities throughout the area, indicate a sulfur content of less than one percent, ash content of from 4.2 to 8.3 percent, and heat value generally ranging from 8,650 to 9,840 Btu/lb (Wegemann and others, 1928). An analysis of the Anderson coal at the Antelope Creek Mine (NW 1/4, sec. 35, T. 41 N., R. 71 W.) shows 4.2 percent ash, 0.4 percent sulfur, and 9,950 Btu/lb (V.E. Swanson, U.S. Geological Survey, written commun., 1975).

A significant property of the coal from the Anderson-Wyodak seam is its low sulfur content, which requires little processing to meet established environmental standards when burned. Primary interest in the Anderson-Wyodak coal bed, in the south half of the Powder River Basin, centers on the vast quantities of coal that lie within 200 ft of the surface and can be strip mined over large areas.

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TABLE 1.—*Coal Strip Mines in the South Half of the Powder River Basin, Northeastern Wyoming*

Map Reference Number	Mine Name	Mine Location
	Campbell County, Wyoming	
1	Coal Creek	NW¼ sec. 17, T. 46 N., R. 70 W.
2	Jacobs Ranch	SW¼ sec. 10, T. 43 N., R. 70 W.
3	Black Thunder	Center 5½ sec. 28, T. 43 N., R. 70 W.
4	North Antelope	NW¼ sec. 16, T. 41 N., R. 70 W.
	Converse County, Wyoming	
5	South Antelope Creek	NW¼ sec. 35, T. 41 N., R. 71 W.
6	Johnston	SW¼ sec. 35, T. 36 N., R. 75 W.

CONVERSION FACTORS

Multiply	By	To obtain
inches (in)	2.54	centimeters (cm)
feet (ft)	0.3048	meters (m)
miles (mi)	1.609	kilometers (km)

ON–WYODAK COAL BED IN THE SOUTH HALF OF THE POWDER RIVER BASIN, NORTHEASTERN WYOMING

By

N.M. Denson and C.T. Pierson

1991

INDEX MAP SHOWING NAMES OF U.S. GEOLOGICAL SURVEY 30' × 60' QUADRANGLES FROM WHICH BASE MAP WAS PREPARED. [Quadrangle corners and map names are shown on geologic map]

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